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# PRESENT SITUATION AND CHARACTERISTICS OF RESEARCH ACTIVITIES IN COSTA RICA

Preliminary Report

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## 2. SOCIO-ECONOMIC CHARACTERISTICS OF PRESENT-DAY COSTA RICA

The last three decades have seen a drastic decrease in the rate of population growth in Costa Rica. In the fifties the population grew at a rate of 4.0%, while in the sixties and seventies the rate of growth came down to 3.4% and 2.6% respectively. This is generating a lower pressure on the school system, although the population under 20 years of age is still 50% of the total.

A substantial part of the population (total population is 2,270,610) lives in urban centres (46.9%), although in most instances this means medium and small towns. One of the outstanding characteristics of Costa Rica is its very high literacy rate: 96% for the urban population and 85% for its rural population. This reflects the strong support that the government has given to the development of the educational system: 5% of the GDP is spent in education, which is one of the highest investments in education in relative terms in Latin America and the Caribbean. In 1979 28.4% of the central government budget went to this sector.

Another basic service that has received considerable attention and that has improved substantially has been that of health. The general mortality index dropped from 11.7 per thousand inhabitants in 1950 to 4.1 per thousand in 1978; infant mortality dropped from 97.4 per thousand in 1950 to 25.0 in 1978. Life expectancy at birth had increased to 70 years by 1978.

The production of the Costa Rican economy measured in terms of GDP was $41,535 million colones in 1980, which was equivalent to US$4,830 million dollars at the rate of exchange of that year (8.60 colones to the dollar). This represents a per capita GDP of US$2,151.* The sectorial distribution of the GDP is as follows (for 1980):

- Agriculture (primary sector): 17.8%
- Industry, construction and mining (secondary sector): 28.4%
- Services (tertiary sector): 53.8%

Despite this distribution agriculture is still the predominant productive activity in the country. In fact, coffee, bananas, sugar and cacao represent 64% of the value of exports.

As the above-mentioned indicators clearly point out, Costa Rica is not representative of Central American countries from the point of view of its level of development. In terms of some of these indicators (i.e., GDP per capita, literacy level, health situation, etc.), Costa Rica occupies a very prominent place in all of Latin America and the Caribbean.

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* The GDP per capita changed drastically after the devaluation of the colon in 1981 (342%). This information refers to the pre-davaluation situation.

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Despite this situation, the country is confronting all the problems and dilemmas of development. In the last year a major recession and financial crises has set in. Some of the indicators of the magnitude of this recession and financial crises are as follows:

- GDP had been growing steadily during the 1970-79 period at an average annual rate of growth of 6.1%. In 1980 it was down to 1.2% and in 1981 the value of the GDP decreased by -2.4%. The biggest fall came in the construction industry.

- The contraction of production has been even more drastic: 1981 witnessed a decrease of industrial production of -4.6%. It is the first time the country faces a negative rate of industrial growth ever since industrialization started two decades ago.

- The public external debt is estimated at US$2,800 million dollars. The service of the debt alone represents a very high percentage of the value of exports. Due to the lack of foreign currency imports have been drastically curtailed. As a result of this situation, the government is renegotiating the public external debt and a new agreement with the IMF is underway.

- In the last year the colon has been devalued by 342%, from 8.60 per dollar to 38.0 per dollar (free banking rate). Inflation has jumped from 18% annually in the recent past to approximately 65%.

This situation is having a serious effect on family income and on the level of living Costa Rica has had over the past years.

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## 3. THE SCIENTIFIC COMMUNITY: HUMAN RESOURCES WORKING IN RESEARCH

The scarcest resource a country has in the area of research is the manpower to carry it out. Well qualified researchers are scarce, and quite often they are difficult to retain in research centres or academic institutions because of the salary levels. Besides a good university training, researchers should have two additional characteristics: an adequate training and experience in research techniques, and an ability to relate his scientific knowledge to the practical problems of development that his society confronts. This set of characteristics is not easy to find in many individuals. Thus the development of adequately trained human resources is one of the principal components in the development of a local research capacity.

This section analyzes three main aspects related to the formation and growth of a scientific community in Costa Rica. In the first place, the magnitude and distribution of high-level human resources in the country (with third-level educational degree), which can be taken as an estimate of the size and composition of the professional community. Secondly, the recent evolution of university enrollment and the relative importance of the scientific and technological disciplines within it. Thirdly, the size and distribution of the research community as such (those who are specifically working in research), which is a much smaller component of the broader professional community existing in the country.

Table 1 shows the evolution of high-level human resources in Costa Rica from 1963 to 1978, with an estimated projection to 1985 based on recent trends. By high-level manpower we refer in this study to persons with a professional (university level) or technical training. By 1978 there were 35,345 professionals and technicians in the country, of which 15,591 constituted the "professional community" in the strict sense of the word (this is over a total population of 2,098,531 for that year). It should be pointed out that Table 1 is based on census data related to occupation, and not to the discipline in which the person is trained. By far the largest single occupational group within the professional community was that of university professors. There is a very small number of persons working as chemists, physicists, agronomists, veterinarians or biologists (only 3.2%). It is interesting to note that the relationship between professionals and technicians has been changing over this period, with the former representing an increasingly higher proportion of the total. This is a consequence of the rapid expansion of university enrollment in the last years.

Table 2 shows the evolution of university enrollment between 1975 and 1980. The largest and most important university is the University of Costa Rica, which underwent a process of expansion in this last six years. But an important part of the increase in university enrollment is due to the growth of two relatively recent universities: the Instituto Tecnológico de Costa Rica, created in 1971 (mainly engineering disciplines), and the Universidad Nacional, created in 1974. In this three universities total enrollment jumped from 29,540 in 1975 to 48,010 in 1980.

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TABLE 1

High-Level Human Resources by Occupation: 1963-1985

| Occupation: | 1963 | | 1973 | | 1978 | | 1985 | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| 1. Professionals: | 4.525 | 39.7 | 11.671 | 40.0 | 15.591 | 44.1 | 30.267 | 49.8 |
| 1.1 Architects and Engineers | 643 | 5.6 | 1.229 | 4.2 | 2.129 | 6.0 | 2.983 | 4.9 |
| 1.2 Chemists, Physicists & Scientists | 73 | 0.6 | 324 | 1.1 | 489 | 1.4 | 627 | 1.0 |
| 1.3 Agronomists, Veterinarians and Biologists | 415 | 3.6 | 754 | 2.6 | 645 | 1.8 | 2.114 | 3.5 |
| 1.4 Doctors, dentists & Pharmacologists | 1.009 | 8.9 | 1.748 | 6.0 | 2.035 | 5.8 | 3.968 | 6.5 |
| 1.5 Professors | 1.286 | 11.3 | 5.132 | 17.6 | 6.950 | 19.7 | 14.662 | 24.1 |
| 1.6 Social Scientists | 371 | 3.3 | 1.461 | 5.0 | 1.104 | 3.1 | 3.438 | 5.7 |
| 1.7 Lawyers, Judges and Notaries | 728 | 6.4 | 1.023 | 3.5 | 2.239 | 6.3 | 2.475 | 4.1 |
| 2. Technicians: | 6.125 | 53.7 | 15.139 | 51.9 | 15.912 | 45.0 | 19.704 | 32.4 |
| 2.1 Topographers and Surveyors | 0 | 0 | 688 | 2.4 | 606 | 1.7 | 937 | 1.5 |
| 2.2 Microbiologists and Laboratory Technicians | 118 | 1.1 | 173 | 0.6 | 470 | 1.3 | 954 | 1.6 |
| 2.3 Nurses & Paramedical Workers | 152 | 1.3 | 756 | 2.6 | 1.223 | 3.5 | 2.468 | 4.1 |
| 2.4 School teachers & Social Workers | 5.855 | 51.3 | 13.522 | 46.3 | 13.613 | 38.5 | 15.345 | 25.2 |
| 3. Managers and Administrators | 759 | 6.6 | 2.358 | 8.1 | 3.842 | 10.9 | 10.809 | 17.8 |
| TOTAL | 11.409 | 100.0 | 29.168 | 100.0 | 35.345 | 100.0 | 60.780 | 100.0 |
| Total Population for that Year | 1.302.829 | | 1.867.045 | | 2.098.531 | | 2.484.520 | |

Source: Population census of 1963 and 1973. Employment survey of the Ministry of Labor of 1978. Projection to 1985 done by "Oficina de Planificación Nacional y Política Económica" (OFIPLAN).

TABLE 2

University Enrollment by Discipline: 1975-1980

| Disciplines | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | % Participat. 1975 | % Participat. 1980 | Annual Rate of Growth |
|---|---|---|---|---|---|---|---|---|---|
| 1. Natural Sciences | 2.177 | 2.590 | 3.020 | 3.610 | 4.200 | 4.690 | 7.4 | 9.8 | 16.6 |
| 2. Engineering and Architecture | 2.259 | 3.050 | 3.410 | 3.630 | 3.690 | 3.740 | 7.6 | 7.8 | 10.6 |
| 3. Agronomy | 1.060 | 1.420 | 1.710 | 1.940 | 2.050 | 2.110 | 3.6 | 4.4 | 14.8 |
| 4. Health Sciences | 1.481 | 1.980 | 2.410 | 2.820 | 3.020 | 3.180 | 5.0 | 6.6 | 16.5 |
| Sub-Total | 6.977 | 9.040 | 10.550 | 12.000 | 12.960 | 13.720 | 23.6 | 28.6 | 14.5 |
| 5. Social Sciences | 4.359 | 5.240 | 5.990 | 6.870 | 7.570 | 8.110 | 14.8 | 16.9 | 13.2 |
| 6. Humanities, Law & Education | 18.204 | 20.070 | 22.220 | 23.630 | 24.430 | 24.710 | 61.6 | 51.5 | 6.3 |
| 7. Others | - | 120 | 480 | 840 | 1.220 | 1.470 | - | 3.0 | * |
| Sub-Total | 22.563 | 25.430 | 28.690 | 31.340 | 33.220 | 34.290 | 76.7 | 71.4 | 8.7 |
| TOTAL | 29.540 | 34.470 | 39.240 | 43.340 | 46.180 | 48.010 | 100.0 | 100.0 | 10.2 |

* The rate of growth of this category is very high (87.1), but it is distorted because of a very small base in the initial year.

Source: CONARE: Plan Nacional de Educación Superior 1976-1980, San José, Costa Rica.

It should be noted that the largest increase came in the "scientific and technological" disciplines (i.e. natural sciences, engineering and architecture, agronomy and health sciences.) 1/. Their share of total university enrollment increased from 23.6% in 1975 to 28.6% in 1980 (see Table 2). The social sciences also increased their share, by going from 14.8% to 16.9% during this time period. The higher increase of all of these disciplines was achieved at the expense of the "humanities, law and education", whose relative share of university enrollment fell from 61.6% to 51.5% between the two years of reference. Nevertheless, the latter still represents slightly over one half of the university population. The highest average annual rates of growth were reached in natural sciences and in health sciences.

A much smaller component of the professional community previously mentioned, is the research community as such, which is the group directly related to the main objective of this study. An operational definition of "researcher" was used in this survey: a researcher is considered to be any person with a university degree (or equivalent level of experience), who at the time of this study (second semester of 1981) was carrying out a research project in one of the institutions included in the survey. Thus this study does not identify persons who have carried out research in the past, nor persons who could be considered as potential researchers because of their level of training. It refers only to "active researchers".

It should also be pointed out that the figures that are presented in the following pages refer only to researchers. They do not include support or auxiliary personnel related to research projects.

The survey on research activities that was carried out in 1981 identified 850 persons working in 737 research projects in Costa Rica at that time. Nevertheless, the 850 persons are not full-time researchers. Many have different types of occupations, such as university professors, with only a partial dedication to research. Thus this figure represents an overestimate of the human resources working in this activity. In order to compensate for this, an index was used to estimate the number of "equivalent full-time researchers", in which the number of researchers was deflacted by the amount of time really dedicated to research. 2/

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1/ In this we are following the definition of "scientists and engineers", used in the international classification of occupations.

2/ Each researcher was asked what proportion of his time he dedicated to research (one fourth, one half or full-time). Each case was multiplied by this proportion in order to estimate its value in terms of"equivalent full-time researchers".

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By applying this index, the number of 850 persons doing research in the country was reduced to 411 equivalent full-time researchers (less than half of the first figure). The difference between the number of "physical persons" related to research and the number of "equivalent full-time researchers" in the three institutional sectors in which researchers work (universities, government research centres and private research centres), is as follows:

| Institutional Sector | No. of Persons Doing Research | No. of Equivalent Full-Time Researchers |
|---|---|---|
| 1. Universities | 642 ( 75.5) | 237 ( 57.7) |
| 2. Government Research Centres | 168 ( 19.8) | 142 ( 34.5) |
| 3. Private Research Centres | 40 ( 4.7) | 32 ( 7.8) |
| TOTAL: | 850 (100.0) | 411 (100.0) |

The above figures clearly point out that the largest number of researchers is to be found in the universities. But it is also in this sector that there is the largest difference between the two indicators of number of researchers. This is due to the fact that it is precisely in the university sector where there is the greatest number of part-time researchers, with a very substantial part of their time and responsibility being dedicated to teaching. In the government and private research centres, on the other hand, most researchers tend to be full-time researchers, thus showing a very small difference between the two indicators.

Since the number of equivalent full-time researchers is a more realistic indicator, we will use this second-indicator in all the analysis of the characteristics and distribution of researchers. Thus 57.7% of the research community is in the universities, 34.5% works in government research centres and 7.8% is to be found in private research centres.

It should be pointed out that the term "research community" is being used in a very broad and loose sense in this study. Close ties and interactions do not exist between the different members or groups that make up this community. In fact, it could be argued that a community does not exist in the strict sense of the word, because of its very low degree of integration. As in many developing countries, it is quite often the case that researchers have more contacts with colleagues and groups in developed countries, than with researchers working in a similar topic in their own country, or in neighboring countries in the same region. Thus the integration of the different components of an incipient research community, at least around common research areas of interest to a group of persons, is one of the problems that confront developing countries in the field of science and technology.

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Table 3 shows the distribution of the active researchers in Costa Rica in terms of the main research areas in which they work (section A), and in terms of the scientific discipline of the researcher (section B). By far the largest number of researchers is in agriculture, forestry and fisheries (37.3%), with socio-economic research (social sciences) and health research coming in second and third place. If the discipline of the research is considered (section B of Table 3), the low participation of engineers in the research community is quite notorious. Natural scientists are the second largest group after the agronomists.

In 1978 CONICIT carried out another study on the scientific community in Costa Rica 3/. This study uses the concept of "scientists" instead of researcher, although the definition is very similar. Besides the actual dedication to research, this study tried to take into consideration additional criteria in the definition of a scientist, such as being considered as a scientist by a group of relevant peers, and the presence or absence of scientific publications. These two additional criteria were possible because the study involved in-depth interviews with researchers.

The results obtained by this previous study are very similar to the results that have been presented for the 1981 survey of research activities, in terms of the magnitude and distribution of the scientific community in Costa Rica. The 1978 study found 754 scientists who were related to research in the country, of which 219 were considered to be "active scientists" (actively engaged in research with a significant dedication of time). Although this second concept is different from that of "equivalent full-time researchers", both indicators try to identify the active central core of the national scientific community. The figures of 754 and 219 found in the 1978 study are quite comparable to those of 850 and 411 found in 1981. The second study has a broader coverage of research centres outside the university sector.

The distribution of the research community in terms of the scientific discipline in which the researcher is working found in 1978, is very similar to the one that is presented in section B of Table 3 for the 1981 survey. The 1978 study does provide additional information on the scientific community that is not available from the 1981 data that is being analyzed in the present report. One of these aspects that it is important to summarize here is the "educational profile" of the research community that was found in 1978. Considering both the total number of scientists that were interviewed (754) and the smaller group of "active scientists" (219), the educational level (highest university degree

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3/ Miguel Gomez B. and Vera V. Bermudez: Encuesta sobre Científicos Activos en Costa Rica (1978): Descripción de la Metodología y Presentación de Algunos Resultados; San José, Costa Rica; CONICIT, 1979.

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TABLE 3

Number of Researchers by Research Area, Discipline & Institutional Sector: 1981

(Equivalent Full-Time Researchers)

| Research Area: (Section A) | Institutional Sector: | | | TOTAL | |
|---|---|---|---|---|---|
| | Universities | Govt. Research Centers | Private Research Centres | No. | % |
| 1. Natural resources and environment | 33 | - | - | 33 | 8.0 |
| 2. Agriculture, forestry, fisheries | 42 | 97 | 14 | 153 | 37.3 |
| 3. Mining | 3 | - | - | 3 | 0.7 |
| 4. Industrial technology | 10 | - | - | 10 | 2.4 |
| 5. Energy | 10 | - | - | 10 | 2.4 |
| 6. Housing & construction | 7 | - | - | 7 | 1.7 |
| 7. Trasport and telecommunications | 1 | - | - | 1 | 0.3 |
| 8. Health | 31 | 42 | - | 73 | 17.8 |
| 9. Social development | 79 | 3 | 18 | 100 | 24.3 |
| 10. Basic knowledge | 21 | - | - | 21 | 5.1 |
| TOTAL | 237 | 142 | 32 | 411 | 100.0 |
| % | 57.7 | 34.5 | 7.8 | - | 100.0 |
| Discipline of Research: (Section B) | | | | | |
| 1. Natural sciences | 90 | - | - | 90 | 21.9 |
| 2. Agronomy | 26 | 97 | 14 | 137 | 33.3 |
| 3. Engineering | 30 | - | - | 30 | 7.3 |
| 4. Health | 23 | 42 | - | 65 | 15.8 |
| 5. Social sciences | 68 | 3 | 18 | 89 | 21.7 |
| TOTAL | 237 | 142 | 32 | 411 | 100.0 |

obtained) is as follows (in percentages): 4/

| Educational Level | Active Scientists | Total Scientists |
|---|---|---|
| 1. No university degree | 2.7 | 7.8 |
| 2. Basic university degree | 32.9 | 50.6 |
| 3. Master | 22.8 | 19.4 |
| 4. Ph.D. | 41.6 | 22.2 |
| TOTAL: | 100.0 | 100.0 |

Thus 41.6% of the total number of scientists related to research have graduate training; this proportion goes up to 64.4% if we consider only the smaller group of active scientists (active researchers).

Another important characteristic is the publishing behaviour of the scientific community. The distribution of active scientists (1978 study) in terms of the number of publications each one has, and in terms of the type of publication, can be summarized as follows (in absolute number of scientists and percentages in parenthesis): 5/

| No. of Publications | Type of Publication : Articles in National & Central American Journals | Articles in Journals Outside the Region : | Books |
|---|---|---|---|
| None | 87 (39.7) | 70 (32.0) | 87 (39.7) |
| 1 to 3 | 70 (32.0) | 75 (34.2) | 70 (32.0) |
| More than 3 | 58 (26.5) | 70 (32.0) | 58 (26.5) |
| No information | 4 ( 1.8) | 4 ( 1.8) | 4 ( 1.8) |
| TOTAL: | 219(100.0) | 219(100.0) | 219(100.0) |

These figures clearly show that about one-third of the scientific community has a very low level of publication. Nevertheless, 66% has published articles in foreign journals outside the Central American region, and 57% has published books on their work. We are not considering mimeographed documents and other type of written material as publications in this analysis. Much of the research results and research reports that are produced by Costa Rica researchers, as it is the case in many developing countries, remain at the level of mimeographed documents with a

4/ Ibid, Table 9.2, p. 31.

5/ Ibid, summarized from Tables A-16, A-17 and A-18, pp. 54-56.

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very limited circulation. If these reports and articles are considered publications, then all of the active scientists have published something as part of their research activity.

The limited availability of good and up-to-date bibliographical material, and the limited access to specialized foreign journals, was mentioned by many researchers as an important obstacle to research in the country. In fact, this problem will most likely tend to become more acute in the near future because of the shortage of foreign currency.

With respect to the pattern of consultation of scientific journals from the point of view of the country in which they are published, most scientific journals come from North America. The proportion of scientists that consult journals from different countries is as follows: 6/

| COUNTRY: | % |
|---|---|
| Costa Rica | 30.7 |
| Central America | 5.8 |
| US and Canada | 60.8 |
| Europe | 47.1 |
| Mexico and South America | 20.6 |
| Other Regions | 6.3 |

The percentages do not add up to 100.0, since each figure represents the proportion of active scientists who consult journals from each geographic region. Thus, only 30.8% of scientists consult journals published in Costa Rica, while 60.8% of them consult journals coming from the U.S. or Canada. Another interesting fact that emerges from these figures is the very limited exchange of scientific journals among the Latin American and Caribbean countries. Only a very small proportion of Costa Rican researchers ever consult journals coming from other Central American (5.8%) or South American(20.6%) countries.

Both the institutional context in which the research community works, as well as the main activities it carries out, are analyzed in the next section.

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6/ Ibid, taken from Table A-15, p. 53.

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## 4. PRESENT CHARACTERISTICS AND ORIENTATION OF RESEARCH IN COSTA RICA

This preliminary report of the survey of research activities that was carried out in 1981 provides information on thirteen research institutions in the country. Although data on a few other institutions is still being processed and tabulated, these thirteen institutions represent approximately 90% of the research that is carried out in the country. Thus the final report that will appear in a few months, with all the information, will not present a substantially different picture.

### 4.1 Coverage of Survey

The 13 research institutions that are analyzed in this report may be classified into one of three institutional sectors:

- Universities
- Government research centres
- Private research centres

The three main universities of the country were covered in this survey: Universidad de Costa Rica, Universidad Nacional and Instituto Tecnológico de Costa Rica. In the public sector, five government research centres were covered:

- The Division of Agricultural Research of the Ministry of Agriculture.
- The "Instituto Costarricense de Investigación y Enseñanza en Nutrición y Salud" (INCIENSA) (Costa Rican Institute of Research and Training in Nutrition and Health).
- The research centre of the National Tobacco Council (Junta de Tabaco).
- The Ministry of Health.
- CONICIT (National Council of Scientific and Technological Research).

Finally, five research centres were covered in the private sector:

- Tabacalera Costarricense (tobacco growers).
- National Association of Banana Growers (ASBANA).
- Costa Rican Demographic Association.
- "Consejeros Económicos y Financieros" (CEFSA) (Economic and Financial Analysts).
- The "Academia of Central America".

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It should be pointed out that this survey did not attempt to cover two important institutional sectors or types of research centres, that are not part of the national research infrastructure in the strict sense of the word, although they are located in the country.

a) International or regional research centres located in Costa Rica. Three outstanding examples of this are IICA and CATIE in agricultural research, and CSUCA (Central American Council of Universities) in social science research.

b) Research centres of multinationals located in Costa Rica (i.e. United Brands - Compañía Bananera de Costa Rica).

The reason for this is that this survey refers basically to the national research infrastructure and capacity, of which these two types of research centres do not really form part. The final reports will include information on the international and regional research centres (located in Costa Rica) as a separate category, for comparative purposes with the national research groups. Information on research activities of multinationals is very hard to obtain, and will not be included in this study.

Another characteristic of this institutional infrastructure is that it includes institutions of very different size. The University of Costa Rica, for example, is the largest institution, with sixteen different research centres or groups within it (see Annex I). The Ministry of Agriculture also has several research departments in different fields. On the other hand, the private research centres are quite small and homogeneous units, with a few researchers. Annex I provides a list of the "research units" or research groups that comprise each of these institutions.

## 4.2 Overall View of the Total Research Effort

Five quantitative indicators were used in the 1981 survey, in order to analyze the magnitude, orientation and distribution of research activities in Costa Rica. These indicators are: number of research projects, financial resources dedicated to research (research costs), number of researchers, average size of research projects, and investment in R and D (financial resources) expressed as a percentage of GDP.

These five indicators give the following overview of the level or magnitude of research activity in the country:

1) Total Number of research projects identified in 1981: 737.

2) Financial resources dedicated to research by the institutions included in the survey (Cost of previously mentioned research projects):

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a) In colones: $81,332,991.

b) In US dollars: $5,186,037. 7/

3) Number of researchers (see previous section):

a) 850 persons doing research.

b) Equivalent to 411 full-time researchers.

4) Average size of research projects:

a) In colones per project: $110,357 per project.

b) In US dollars per project: US$ 7,037 per project.

c) In number of equivalent full-time researchers per project: 0.6 full-time researcher per project.

5) Investment in R and D as a percentage of GDP: for 1981 the financial resources dedicated to research represent 0.20% of the GDP for that year.

The above figures point out that although 737 research projects were identified in 1981, these projects tend to be quite modest in size: US$ 7,037 (dollars) per project, with less than one full-time researcher per project. It should be pointed out, though, that this refers only to local support for research. Several of the research projects are really quite larger, since they have partial foreign support which is not reported in these figures. Moreover, the local investment in research is somewhat underestimated, since this information only includes the actual costs of the operation of the research projects. It does not include institutional overhead, nor fixed costs that form part of the research infrastructure of these centres (laboratories and research equipment already owned by the centre, etc.).

The values of these indicators at the aggregate national level give an idea of the overall magnitude of the research effort, but it has to be realized that there are very important differences between institutions, between sectors or among different research areas, that the aggregate value of indicators do not reflect. These differences will come out in the subsequent analysis that is made of the distribution of the research effort according to different criteria.

## 4.3 Role of the Different Institutional Sectors in Research

Table 4 shows the distribution of the research effort in Costa Rica ( as measured by the first four indicators), in terms of the three institutional sectors that carry out research in the country. As it can be seen, the largest

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7/ The rate of exchange used was the average rate of exchange for the first semester of 1981: 15.15 colones to the dollar.

TABLE 4

Distribution of the Research Effort in Terms of the Institutional Sector that Carries out Research

(1981)

| Indicators of Research Activity: | Institutional Sector: | | | Total |
|---|---|---|---|---|
| | Universities | Govt. Research Centers | Private Research Centres | |
| 1. No. of Research Projects: | | | | |
| a) Number | 396 | 306 | 35 | 737 |
| b) Percentage | 53.7 | 41.5 | 4.8 | 100.0 |
| 2. Financial Resources: | | | | |
| a) In Colones | 37,367,811 | 33,632,556 | 10,332,624 | 81,332,99 |
| b) In U.S. dollars* | 2,466,034 | 2,219,531 | 500,472 | 5,186,03 |
| c) Percentage | 47.6 | 42.8 | 9.6 | 100.0 |
| 3. No. of Researchers:** | | | | |
| a) Number | 237 | 142 | 32 | 411 |
| b) Percentage | 57.7 | 34.5 | 7.8 | 100.0 |
| 4. Average size of Research Projects: | | | | |
| a) Colones/Project | 94,363 | 109,910 | 295,218 | 110,35 |
| b) U.S.$/Project | 6,227 | 7,374 | 14,299 | 7,03 |
| c) No. of Researchers/ Project | 0.6 | 0.5 | 0.9 | 0.6 |

* The rate of exchange used for the first semester of 1981 was: US$1.00 = 15.15 Colones. The only exception was some of the projects carried out by private research centres with foreign funding, since they had access to a different market rate of exchange at that moment.

** The number of equivalent full-time researchers is used.

research projects are to be found in the private sector (the average size goes up to US$14,300 per project, with a full-time researcher in charge of it),while the smaller ones are found in the universities. Although the largest number of researchers is located in the universities (57.7%), in terms of financial resources (as the most reliable indicator) the relative importance of the three institutional sectors within the overall research effort that is carried out in the country is as follows (see Table 4):

- Universities: 47.6%
- Government Research Centres: 42.8%
- Private Research Centres: 9.6%

This places Costa Rica in an intermediate position between two extreme institutional patterns that may be identified in some of the Latin American and Caribbean countries. In some of them (i.e. Chile) most of the research (both basic and applied) is carried out in universities; a very small role is played by government and private research centres. In other cases, the role of large government research centres has increased substantially, with a concomitant decrease of the relative importance of university research, specially in the area of applied and technological research. The institutional structure that has evolved in Costa Rica has elements of both patterns with universities and government research centres playing a major role in this area.

It should also be pointed out that government and private research centres only play a role in very specific, and highly mission-oriented, research areas. In Costa Rica government research centres play a significant role only in agricultural research and in health research. In these two areas the role of the state is predominant: 72% of agricultural research and 60% of health research is carried out by government research centres (see Table 6).

Private research centres exist only in two areas: agricultural research and social science research. In agriculture the relationship between research and production is quite often more visible than in other research areas. For this reason associations of growers have, in several cases, decided to collectively set up their own research facilities and research programs (i.e. ASBANA in banana production). In other cases they fund research of interest to them through the government research centres, in order to avoid setting up separate facilities (i.e. the coffee growers through OFICAFE). This pattern of an active participation of the private sector in carrying out or funding research of interest to them, has not yet appeared in other production sectors in Costa Rica (i.e. industry).

The nature of the private research centres in social science is very different. They are normally small offices of "researchers/consultants", who try to survive by combining three sources of funding since they do not have their own funds:

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a) grants from government funds for specific research projects (this possibility is very limited); b) contract research (or consultancy services); and c) foreign financial support from international or bilateral organizations. Depending on the motivation of the persons who make up these centres and on their ability to mobilize funds from these three sources, some groups tend to become more consultants than researchers (with a very marginal research activity), while others keep tight to their research vocation, refusing to be absorbed by the consultancy market.

The situation that has just been described of the private agricultural and social science research centres is quite typical of many Latin American and Caribbean countries. What changes from one country to another is the specific historical reasons that led to the emergence of the private research centres, as well as the relative importance they have within the national research community. For example, in Costa Rica 36.5% of social science research is carried out by private research centres, with the universities still playing the leading role (60%) (see Table 6). In other countries of the region social science research has largely shifted from the universities to private research centres. The most extreme example of this trend is Argentina, where private social science research centres play a predominant role in this field of research.

Besides agriculture, health and social science, all the other research areas are basically in the hands of the university (see Table 6). It is for this reason that many researchers believe that most, if not all, research in Costa Rica is done in the university, since they are basically acquainted only with their area of interest.

## 4.4 Orientation of Research: Main Research Areas that are Being Studied

In order to characterize the orientation of the research effort in Costa Rica, as well as the relationship between research and the development problems of the country, the following classification of research areas was used:

a) Natural resources and environment.
b) Agriculture, Forestry and Fisheries.
c) Mining.
d) Industrial Technology.
e) Energy
f) Housing and development of construction technologies and materials.
g) Transportation and Telecommunications.
h) Health.
i) Social Development (socio-economic development problems or issues).[8/]
j) Basic knowledge.

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8/ The term "social development" is used, instead of social sciences, since we are speaking about applied areas or problems of development. But this category will basically refer to social science research.

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All research projects were classifed into one of these ten categories, on the basis of their objectives and of the potential area of application of their results. It is quite evident that research projects can also be classified in terms of the traditional distinction between scientific areas or disciplines (i.e. natural sciences, social sciences, engineering, agronomy and health sciences).

But the former classification is much more practical for the identification and analysis of the research topics that are attracting the attention of Costa Rican researchers. It also brings out more clearly the relationship between research and development problems.

Table 5 shows the main areas of concentration of research in Costa Rica, both in terms of research areas and in terms of the scientific discipline of the research projects. The three indicators that are used in this table (number of projects, financial resources and number of researchers) show very similar levels or percentages when compared across rows. Thus the three indicators have a relatively homogeneous behaviour in terms of measuring the magnitude or level of research. The distribution of financial resources will be used as the main indicator in this analysis.

Several outstanding facts emerge from the analysis of section A of Table 5. In the first place, a very considerable proportion of the research that is being carried out in the country is related to applied research areas or to development problems. Only 4.1% of the available financial resources goes into research whose main objective is the generation of knowledge per se (basic, non-oriented research). It should be pointed out, though, that some of the research projects related to any of the applied areas are quite "basic" in nature (i.e. this is the case of some of the research in health, agriculture, natural resources and social development). This in itself is not a negative aspect, since basic (oriented) research has an important role to play within each of these research areas.

Furthermore, it should also be kept in mind that applied research does not in itself assure that the research results will be effectively used or applied in any of these areas. So the fact that research is being done in these different areas cannot be taken to mean that the results are being effectively applied in each of them. The problems of extension and transfer of results to the potential users are a major concern in most research areas, although several cases of successful adoption and application of results can be mentioned, specially in the area of health and agriculture.

The second important fact that emerges from section A of Table 5 is the very high concentration of the research effort in three major areas: agricultural research (45.7%), research on social development aspects (19.2%) and research in health (15.1%). These three areas absorb 80% of the total financial resources dedicated to research in Costa Rica. In the following pages we will come back

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TABLE 5

Main Areas of Concentration of Research in Costa Rica

by Research Area and Scientific Discipline

(In thousands of Colones and US$)

| Research Area (Section A) | Research Prjs. | | Financial Resources | | | Researchers * | |
|---|---|---|---|---|---|---|---|
| | No. | % | Colones | US$ | % | No. | % |
| 1. Natural resources and environment | 56 | 7.6 | 5.014.0 | 330.9 | 6.4 | 33 | 8.0 |
| 2. Agriculture, forestry, fisheries | 365 | 49.5 | 35.940.0 | 2.371.8 | 45.7 | 153 | 37.3 |
| 3. Mining | 6 | 0.8 | 427.2 | 28.2 | 0.6 | 3 | 0.7 |
| 4. Industrial technology | 14 | 1.9 | 1.608.8 | 106.2 | 2.1 | 10 | 2.4 |
| 5. Energy | 17 | 2.3 | 4.149.2 | 273.8 | 5.3 | 10 | 2.4 |
| 6. Housing and construction | 10 | 1.4 | 1.048.6 | 69.2 | 1.3 | 7 | 1.7 |
| 7. Transport and telecommunications | 1 | 0.1 | 159.2 | 10.5 | 0.2 | 1 | 0.3 |
| 8. Health | 89 | 12.1 | 11.896.2 | 785.1 | 15.1 | 73 | 17.8 |
| 9. Social development | 133 | 18.1 | 17.841.9 | 996.0 | 19.2 | 100 | 24.3 |
| 10. Basic knowledge | 46 | 6.2 | 3.247.9 | 214.3 | 4.1 | 21 | 5.1 |
| TOTAL | 737 | 100.0 | 81.333.0 | 5.186.0 | 100.0 | 411 | 100.0 |
| Scientific Discipline of The Research (Section B) | (Idem) | | | | | | |
| 1. Natural sciences | 132 | 17.9 | 12.778.8 | 843.3 | 16.3 | 90 | 21.9 |
| 2. Agronomy | 345 | 46.8 | 34.198.1 | 2.256.9 | 43.5 | 137 | 33.3 |
| 3. Engineering | 50 | 6.8 | 7.381.9 | 487.2 | 9.4 | 30 | 7.3 |
| 4. Health sciences | 84 | 11.4 | 10.926.8 | 721.1 | 13.9 | 65 | 15.8 |
| 5. Social sciences | 126 | 17.1 | 16.047.4 | 877.5 | 16.9 | 89 | 21.7 |
| TOTAL | 737 | 100.0 | 81.333.0 | 5.186.0 | 100.0 | 411 | 100.0 |

*Number of equivalent full-time researchers.

TABLE 6

Distribution of the Research Effort by Research Area and Institutional Sector

(In thousands of Colones and US dollars)

| Research Area: | Institutional Sector: | | | TOTAL | |
|---|---|---|---|---|---|
| | Universities | Govt. Research Centers | Private Research Centers | Colones | U.S.$ |
| 1. Natural resources and environment | 5.014.0 | - | - | 5.014.0 | 330.9 |
| 2. Agriculture, forestry, fisheries | 6.223.8 | 25.904.9 | 3.811.3 | 35.940.0 | 2.371.8 |
| 3. Mining | 427.2 | - | - | 427.2 | 28.2 |
| 4. Industrial technology | 1.608.8 | - | - | 1.608.8 | 106.2 |
| 5. Energy | 4.149.2 | - | - | 4.149.2 | 273.8 |
| 6. Housing and construction | 1.048.6 | - | - | 1.048.6 | 69.2 |
| 7. Transport and telecommunication | 159.2 | - | - | 159.2 | 10.5 |
| 8. Health | 4.720.6 | 7.175.6 | - | 11.896.2 | 785.1 |
| 9. Social development | 10.768,5 | 552.0 | 6.521.4 | 17.841.9 | 996.0 |
| 10. Basic knowledge | 3.247.9 | - | - | 3.247.9 | 214.3 |
| TOTAL | 37.367.8 | 33.632.5 | 10.332.7 | 81.333.0 | 5.186.0 |

Percentage Distribution

(by row)

| | | | | |
|---|---|---|---|---|
| 1. Natural resources and environment | 100.0 | - | - | 100.0 |
| 2. Agriculture, forestry, fisheries | 17.3 | 72.1 | 10.6 | 100.0 |
| 3. Mining | 100.0 | - | - | 100.0 |
| 4. Industrial technology | 100.0 | - | - | 100.0 |
| 5. Energy | 100.0 | - | - | 100.0 |
| 6. Housing and construction | 100.0 | - | - | 100.0 |
| 7. Transport and telecommunication | 100.0 | - | - | 100.0 |
| 8. Health | 39.7 | 60.3 | - | 100.0 |
| 9. Social development | 60.4 | 3.1 | 36.5 | 100.0 |
| 10. Basic knowledge | 100.0 | - | - | 100.0 |

to these three major areas of research, in order to analyze them further in terms of the main research topics that are being covered in each one.

The third fact that is underlined by Table 5 (section A) is the very little attention that is being given to research in certain areas of interest to the country, such as energy and mineral resources. Industrial technological research is also notoriously low. Since the ten categories that are used to analyze the main research areas that are receiving attention in Costa Rica are, by necessity, at a very aggregate level, Table II-1 in Annex II presents more detailed information on the specific research topics that are being studied in each area. In the case of the three main research areas (agriculture, social development and health), this is also analyzed in the following pages and in Tables 7, 8 and 9.

The distribution of research in terms of the scientific discipline it refers to (section B of Table 5) does not add much to the previous analysis. Again, the concentration of the research effort in the fields of agronomy, social sciences and health sciences is quite evident, although in a somewhat lower proportion. This second section of Table 5 also points out that an important part of the research that is being carried out in the different applied areas is related to the natural sciences. The engineering sciences, on the other hand, show a very weak participation in research.

As it was previously pointed out, the role of the three institutional sectors that carry out research (universities, government research centres and private research centres) varies widely from one research area to another (see Table 6). Government research centres are predominant in agricultural and health research, but they practically play no role in the other research areas (with the exception of a very marginal participation in social science research). Private research centres have an active participation only in social science research (social development) and in agricultural research, although at a more modest level. The university sector plays a predominant role in the other research areas, including a leading role in social science research.

The analysis of the previous pages gives a broad picture, at a very aggregate level, of the general orientation of research in Costa Rica. We will now return to a more detailed analysis of the main research topics that are being studied in the three principal research areas: agriculture, social development and health.

Agricultural Research

A very substantial portion of agricultural research is being devoted to agricultural production: 60.2% of the funds goes to research on the main agricultural crops that are produced by the country (see Table 7). At a much lower level, three other research topics that receive substantial support are forestry (13.9%), animal production (9.7%) and fisheries (6.6%). The other research topics only

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TABLE 7

Major Topics that Predominate in Agricultural Research in Costa Rica

(In thousands of Colones and US$)

| Major Topics of Agricultural Research | No. Res. Projs. | Financial Resources | | | No. of Researchers* |
|---|---|---|---|---|---|
| | | Colones | U.S.$ | % | |
| 1. Agricultural production** | 263 | 21.644.9 | 1.428.4 | 60.2 | 88 |
| 2. Forestry** | 14 | 4.984.3 | 328.9 | 13.9 | 19 |
| 3. Animal production ** | 33 | 3.499.7 | 231.0 | 9.7 | 19 |
| 4. Post-production ** | 7 | 648.1 | 42.8 | 1.8 | 4 |
| 5. Fisheries | 18 | 2.349.1 | 155.0 | 6.6 | 14 |
| 6. Soil management | 19 | 871.1 | 57.5 | 2.4 | 4 |
| 7. Cropping systems | 11 | 825.4 | 54.5 | 2.3 | 5 |
| 8. Others | - | 1.117.4 | 73.7 | 3.1 | - |
| TOTAL | 365 | 35.940.0 | 2.371.8 | 100.0 | 153 |

Disaggregation of agricultural production research in terms of crops:

| | | | | | |
|---|---|---|---|---|---|
| 1.1 Rice | 10 | 1.022.4 | 67.5 | 4.7 | 2.0 |
| 1.2 Bananas, plantains | 6 | 1.202.3 | 79.3 | 5.5 | 6.0 |
| 1.3 Cocoa | 7 | 400.9 | 26.5 | 1.8 | 2.5 |
| 1.4 Sugar cane | 14 | 1.722.3 | 113.7 | 8.0 | 4.2 |
| 1.5 Fruitculture | 29 | 2.510.5 | 165.7 | 11.6 | 10.6 |
| 1.6 Horticulture | 15 | 1.961.6 | 129.4 | 9.1 | 5.8 |
| 1.7 Grain legumes | 24 | 1.295.5 | 85.5 | 6.0 | 9.5 |
| 1.8 Corn, wheat | 17 | 2.056.5 | 135.7 | 9.5 | 6.1 |
| 1.9 Roots, tubers | 15 | 1.023.8 | 67.5 | 4.7 | 3.2 |
| 1.10 Cotton | 4 | 418.3 | 27.6 | 1.9 | 0.4 |
| 1.11 Sorghum | 6 | 490.3 | 32.3 | 2.3 | 0.8 |
| 1.12 Coffee | 18 | 4.244.0 | 280.1 | 19.6 | 15.1 |
| 1.13 "Pejibaye" | 4 | 569.6 | 37.6 | 2.6 | 1.9 |
| 1.14 Tobacco | 5 | 530.5 | 35.0 | 2.5 | 2.3 |
| 1.15 Seed production | 4 | 279.2 | 18.4 | 1.3 | 1.0 |
| 1.16 Plant pathology | 29 | 432.7 | 28.6 | 2.0 | 5.0 |
| 1.17 Entomology | 48 | 930.0 | 61.4 | 4.3 | 9.0 |
| 1.18 Others | 8 | 554.5 | 36.6 | 2.6 | 2.6 |
| TOTAL (Agric. Prod.) | 263 | 21.644.9 | 1.428.4 | 100.0 | 88.0 |

* Number of equivalent full-time researchers.

** Agricultural production is disaggregated in terms of crops in the second part of thi Table. The specific research topics that are receiving attention in forestry, anima production and post-production are presented in Tables II-2, II-3 and II-4 in Annex

play a marginal role. Nevertheless, it should be pointed out that research in cropping systems is sufficiently important to appear in a separate category, apart from agricultural production (2.3% of total funds is devoted to it).

The second part of Table 7 disaggregates the large component of agricultural production research, into the specific crops or production problems (i.e. plant pathology, seed production and entomology) that are presently being studied. The following four categories emerge from the analysis of this table, in terms of the "de-facto" importance that is being given to research in the different products:

a) By far the greatest research effort is being done in coffee, which absorbs practically 20% of the funds allocated to agricultural production research. This, of course, reflects the importance of coffee in the Costa Rican economy.

b) At a second level there is a group of four crops which receive considerable attention in terms of support for research: fruit-culture (11.6%), corn (9.5%), horticulture (9.1%) and sugar cane (8.0%).

c) There is a third group of crops or research topics with an intermediate level of support: bananas (5.5%), rice (4.7%) and research on entomology (4.3%).

d) The other crops are quite low in terms of research expenditure.

It should be kept in mind that these figures include what is being done by the Ministry of Agriculture, the universities and private research centres. It does not refer only to government research, although the latter plays a dominant role.

More detailed information on what is being done in forestry research, animal production research and post-production research is provided in Tables II-2, II-3 and II-4 in Annex II at the end of this report.

Health Research

In the area of health research there is a considerable concentration of the research effort in two major topics (see Table 8): epidemiology, that absorbs 26.7% of the total funds allocated to health research, and nutrition problems, that represents 24.8% of the research expenditure in this area. These two research topics concentrate 51.5% of the resources available for research in health problems. In the area of nutrition research covers such topics as diets, malnutrition, mother/child nutrition and nutrition and child development.

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TABLE 8

Major Topics that Predominate in Health Research in Costa Rica

(In thousands of Colones and US$)

| Major Topics of Health Research: | No. Res. Prjs. | Financial Resources | | | No. of Researchers * |
|---|---|---|---|---|---|
| | | Colones | US$ | % | |
| 1. Rural health | 2 | 198.9 | 13.1 | 1.7 | 1.0 |
| 2. Water supply and sanitation | 1 | 42.4 | 2.8 | 0.4 | 0.3 |
| 3. Bacteriology, microbiology and parasitology | 9 | 691.6 | 45.6 | 5.8 | 5.0 |
| 4. Nutrition and dietetics | 16 | 2.956.8 | 195.1 | 24.8 | 12.7 |
| 5. Biochemestry and human genetics | 9 | 993.7 | 65.6 | 8.3 | 5.0 |
| 6. Traditional medicine | 3 | 185.5 | 12.2 | 1.6 | 1.1 |
| 7. Family planning | 1 | 82.3 | 5.4 | 0.7 | 0.4 |
| 8. Hematology | 3 | 274.4 | 18.1 | 2.3 | 1.5 |
| 9. Immunology | 2 | 136.8 | 9.0 | 1.1 | 0.6 |
| 10. Pharmacology and Therapeutics | 5 | 195.6 | 12.9 | 1.6 | 1.3 |
| 11. Epidemiology | 10 | 3.173.8 | 209.5 | 26.7 | 16.4 |
| 12. Cancerology | 3 | 206.9 | 13.7 | 1.7 | 1.2 |
| 13. Pathology and cytopathology | 4 | 416.5 | 27.5 | 3.5 | 2.0 |
| 14. Physiology and phisiopathology | 2 | 115.1 | 7.6 | 1.0 | 0.5 |
| 15. Toxicology | 6 | 828.9 | 54.7 | 7.0 | 7.7 |
| 16. Social medicine | 4 | 697.3 | 46.1 | 5.9 | 5.7 |
| 17. Mental health | 9 | 699.7 | 46.2 | 5.9 | 10.6 |
| TOTAL | 89 | 11.896.2 | 785.1 | 100.0 | 73.0 |

* Number of equivalent full-time researchers.

A second group of research topics in the area of health that receive an intermediate level of support are the following (at a much lower level than the previous ones):

- Biochemistry and human genetics, that absorbs 8.3% of the resources available for research in this area.
- Toxicology (7.0%)
- Social medicine (5.9% of financial resources), that includes such aspects as the participation of the community in health programs, as well as social aspects related to health problems or to the efficiency of health-delivery systems.
- Mental health (5.9%).
- Bacteriology, microbiology and parasitology (5.8%).

The other topics in the area of health research receive very marginal support in terms of research funds (see Table 8). The interest in such topics as water supply and sanitation and family planning is notoriously low (0.4% and 0.7% respectively).

The main centre for health research is INCIENSA (Costa Rican Institute of Research and Training in Nutrition and Health), which is funded by the government. The University of Costa Rica (i.e. the "Instituto de Investigaciones en Salud", the "Instituto Clodomiro Picado" and the Faculty of Medicine) and, to a lesser extent, the Ministry of Health, are the other two institutions that carry out research in this area.

Social Science Research (Social Development).

In the area of social science research the 1981 survey identified 133 research projects, with a total research expenditure of one million US dollars ($17,841,900 colones) and 100 equivalent full-time researchers. Given the large number of research projects the average size of each one is quite small (US$7,520 per project). Nevertheless, as it was previously pointed out, the figures with respect to research costs have to be handled carefully for two reasons. In the first place, the extremely rapid devaluation of the colon during the last year makes any dollar equivalent of a Costa Rican expenditure a relatively artificial or misleading figure, under present circumstances. Secondly, research costs in university projects are somewhat underestimated, since they do not include all the overhead and personnel costs (mainly support and auxiliary personnel) that are involved in the project. The latter are quite often absorbed by the normal operating budget of the university. 9/ Despite these two factors, there is a

9/ Furthermore, these figures do not include foreign funding for these research projects.

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clear trend towards the atomization of the research effort into a multitude of small projects. A greater concentration of the scarce resources available in a smaller number of projects, would probably yield better results. (This is true not only of social science research but also of the previously analyzed research areas).

For these reasons, the percentage distribution of financial resources in terms of the major research topics being studied, is a more significant indicator (of relative importance) than the absolute figures of research costs.

Table 9 shows the main topics or issues that predominate in social science research in Costa Rica. Four major research topics receive substantial support and concentrate the attention of researchers in this field:

a) Macro-economic and macro-sociological studies of Costa Rican society (societal organization) ranks in first place, with 28 research projects that absorb 21.4% of the financial resources available. This includes projects on such topics as macro-economic models of the Costa Rican economy, economic and social history, employment, industrialization process, foreign investment, and others.

b) Research on population comes second, with 17 projects and 15.8% of the funds. The aspects that are receiving more attention within this area are basically those of the spatial distribution of the population, demographic behaviour, internal migrations and urbanization.

c) At a comparable level of interest and local support we find research on education (30 projects and 15.1% of the funds). The principal issues that are receiving attention from researchers in this field are the following: the learning process, teaching methods and techniques, development and standardization of tests, efficiency of the school system and pre-school education.

d) The fourth major topic that is receiving attention is that of rural development and agricultural economics (15 projects and 14.3% of the funds). Among the main issues that are being studied the following should be mentioned: peasant economy, land tenure, rural employment, collective farming enterprises and studies on the production and marketing of certain crops.

These four major research topics absorb two thirds (66.6%) of the funds available for social science research.

Two additional research topics receive an intermediate level of support: organization and administration of the state (9.9%), which includes public administration, political sociology and political science; and anthropology and cultural development (6.8%). The other topics of social science research receive only a modest support (see Table 9).

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TABLE 9

Major Topics that Predominate in Social Science Research in Costa Rica

(In thousands of Colones and US$)

| Major Topics of Social Science Research: | No. Res. Projs. | Financial Resources | | | No. of Researchers |
|---|---|---|---|---|---|
| | | Colones | U.S.$ | % | |
| 1. Population | 17 | 2.551.5 | 157.6 | 15.8 | 12.6 |
| 2. Rural development & agricultural economics | 15 | 3.285.9 | 142.0 | 14.3 | 11.0 |
| 3. Societal organization: macro-economic and macro-sociological processes. | 28 | 4.679.8 | 213.0 | 21.4 | 23.5 |
| 4. Production & distribution | 2 | 549.6 | 36.3 | 3.6 | 1.2 |
| 5. Organization & administration of the State | 17 | 1.492.9 | 98.5 | 9.9 | 8.8 |
| 6. Urban development | 3 | 538.7 | 35.6 | 3.6 | 4.6 |
| 7. Education | 30 | 2.281.0 | 150.5 | 15.1 | 20.8 |
| 8. Communication & information | 4 | 824.9 | 54.4 | 5.5 | 7.0 |
| 9. Science & technology | 3 | 607.1 | 40.1 | 4.0 | 3.2 |
| 10. Anthropology, art & culture | 14 | 1.030.5 | 68.0 | 6.8 | 7.3 |
| TOTAL | 133 | 17.841.9 | 996.0 | 100.0 | 100.0 |

* Number of equivalent full-time researchers.

An additional study, complementary to this one, is being carried out on the present situation and characteristics of social science research in Costa Rica and Central America. 10/ This other study specifically concentrates on the main obstacles that have limited social science research in Central America, and on some of the principal contributions that this area of research has made to the clarification or solution of development problems.

With respect to the institutional context within which social science research takes place, see section 4.3 of this report.

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10/ Juan Manuel Villasuso: Social Science Research in Central America: Current Situation and Future Perspectives; San Jose, Costa Rica; Economics Research Centre, University of Costa Rica, 1982.

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## 5. EVALUATION OF THE PRESENT RESEARCH EFFORT AND RESEARCH PRIORITIES

As it was pointed out in the previous section, Costa Rica is presently spending 0.20% of its GDP in research programs. This is an average level of research investment that is quite characteristic of many countries in Latin America and the Caribbean, although a few countries in the region are now up to a research investment that represents 0.70% of their GDP.

Nevertheless, the aggregate value of this indicator overlooks important sectorial differences. If we analyze the relationship between research expenditures and GDP at a sectorial level, the picture that emerges in the different sectors is quite different (see Table 10). The only research areas that can be directly related to GDP sectors are those related to production activities: agri-

TABLE 10

SECTORIAL DIFFERENCES OF THE RELATIONSHIP BETWEEN RESEARCH EXPENDITURE AND GDP

(In Thousandsof Colones)

| Sectors of Research Expenditure and of GDP | Research Expenditure (A) | GDP (B) | A/B (%) |
|---|---|---|---|
| Agriculture | 40,954 | 7,204,800 | 0.57 |
| Industry and Mining | 2,036 | 8,123,300 | 0.03 |
| The Rest | 38,343 | 26,206,800 | 0.15 |
| TOTAL: | 81,333 | 41,534,900 | 0.20 |

culture, industry and mining. Such research areas as health and social development (social science) cannot be directly linked to GDP sectors. For this reason Table 10 does not disaggregate further the relationship between research and GDP. It also does not differentiate some other GDP sectors because of a very low level of research activity in them (i.e. construction and transport and telecommunications).

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Table 10 clearly shows that a higher relative effort of research is being done in the agricultural sector, where the relationship between research and sectorial GDP goes up to 0.57%. This is substantially higher than the relative importance of the total research investment, as reflected by the aggregate value of the indicator. On the contrary, the research effort that is being done in industry and mining relative to their sectorial GDP is extremely low (0.03%). In general terms, the relationship between other research areas and the rest of the GDP is very similar to the one reflected in the aggregate index.

Table 11 provides information on the relationship between research expenditure in different agricultural products (not only crops) and the annual value of production for each product. This is another indicator whose main objective is to measure relative importance of the research effort, in terms of the percentage of the total value of production that is "reinvested" in research. Three agricultural products rate quite high in terms of this indicator: grain legumes (3.32%), cotton (2.65%) and corn and wheat (2.11%). It should be pointed out that in those cases where the product has a very low level of production (the denominator), even a low research investment will tend to generate a high value of the indicator. Thus in those extreme cases this indicator should be handled with certain care. This is the case of cotton in Costa Rica, whose index value is out of proportion with the research expenditure. The other products do not have this problem. It is interesting to note in Table 11 that although coffee is by far the most important agricultural research area in terms of research expenditure, the latter represents only a very small percentage (0.22%) of the value of the production of coffee for that year.

## Research Priorities

This paper has concentrated on ongoing research activities in Costa Rica, in terms of their magnitude, distribution and orientation. If the question of the adequacy of the present orientation of research is raised, the issue of research priorities comes to the forefront.

The definition of research priorities is not an easy task, given the different criteria that can be used to define such priorities. In the process of defining research priorities there are three types of factors that are generally taken into consideration:

a) The existing capacity and opinions of the research community, in order to identify what is feasible in the country and what are the research interests of the former.

b) Considerations with respect to the socio-economic importance of alternative research areas or topics.

c) Government development policies and programs, both at a general socio-economic level and in science and technology in particular.

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TABLE 11

Relationship between Research Expenditure and Value of Production by Agricultural Product

(In thousands of Colones)

| Agricultural Products | Value of Production (A) | Research Expenditures (B) | B/A % |
|---|---|---|---|
| 1. Rice | 335.783.5 | 1,022.4 | 0.30 |
| 2. Bananas, plantains | 1.599,028.5 | 1,202.3 | 0.08 |
| 3. Cocoa | 221,593.5 | 400.9 | 0.18 |
| 4. Sugar cane | 351,222.7 | 1,722.3 | 0.49 |
| 5. Grain legumes | 39,048.3 | 1,295.5 | 3.32 |
| 6. Corn, wheat | 97,426.1 | 2,056.5 | 2.11 |
| 7. Roots, tubers | 116,612.6 | 1,023.8 | 0.88 |
| 8. Cotton | 15,799.0 | 418.3 | 2.65 |
| 9. Sorghum | 38,325.4 | 490.3 | 1.28 |
| 10. Coffee | 1.895,831.2 | 4,244.0 | 0.22 |
| 11. Tobacco | 42,810.2 | 530.5 | 1.24 |
| 12. Forestry | 374,082.8 | 4,984.3 | 1.33 |
| 13. Animal production | 2.539,750.2 | 3,499.7 | 0.14 |
| 14. Fisheries | 220,974.2 | 2,349.1 | 1.06 |
| 15. Others | 669,366.2 | 10,700.1 | 1.60 |
| TOTAL | 8.557,654.4 | 35,940.0 | 0.42 |

Ideally, all three factors should converge on a specific set of research priorities clearly identified. In many instances these different factors do coincide and reinforce each other. But in the real world this normally requires a complex and interactive process, involving successive approximations and mutual accommodation among the three factors.

The analysis that has been done in the previous sections is basically related to the first factor: the existing research capacity, research interests and ongoing research programs of the scientific community. The present distribution of financial resources defines an implicit research policy, in terms of what is actually being supported and studied.

A partial consideration of the second factor has been made in the analysis of the relationship between research expenditures and GDP, or between the former and the total value of production of a given crop or product.

A more detailed analysis of the socio-economic importance of alternative research areas and topics would go beyond the scope of this paper.

Finally, with respect to the third factor (government development policies and programs) two main aspects should be mentioned. The first one is the relationship between the nine applied research areas in which the Costa Rican scientific community is working (excluding basic knowledge), and the main sectorial development programs and priorities of the government (as defined in the development plan).

Table 12 summarizes graphically the main sectorial development programs that are related to each research area. Since these sectorial development programs are taken from the National Development Plan 1979-82, they could change either in content or in priority with the incoming government. Although this means that the content of the table will have to be adjusted in a few months, Table 12 does give a general view of the relationship between research and sectorial development problems and priorities in the country.

For each research area the main development problems related to that sector are classified into four levels of priority 10/. Thus, in the case of health the main development problems and programs are classified in the following way:

a) First priority: communicable diseases, extension of medical coverage, nutrition, mother/child care and environmental sanitation.

b) Second priority: none .

c) Third priority: mental and occupational health.

d) Fourth priority: dental health and chronic diseases.

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10/ The priority of the different development problems related to each sector was defined in: OFIPLAN and CONICIT: Areas Prioritarias en Ciencia y Tecnología y su Relación con el Desarrollo; San Jose, Costa Rica, 1981.

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TABLE 12

Relationship Between Research Areas and Main Sectorial Development Programs and Priorities

| Research Areas: | Main Sectorial Programs and Priority Levels: | | | |
|---|---|---|---|---|
| | Priority 1 | Priority 2 | Priority 3 | Priority 4 |
| 1. Natural Resources and Environment | | -Land (soil) survey & classification | | |
| 2. Agriculture, Forestry and Fisheries | -Traditional agricultural exports<br>-Basic grains<br>-Seed production<br>-Soil management | -Irrigation<br>-Non-traditional export products<br>-Livestock products<br>-Forestry | -Fisheries | -Oleaginous plants |
| 3. Mining | | | | -Mining |
| 4. Industrial Technology | -Food industry | -Quality control | -Small industries and cottage industries<br>-Metal working industry<br>-Norms & standards | -Pulp & paper<br>-Wood industry<br>-Leather industry<br>-Textile industry<br>-Chemical industry |
| 5. Energy | -Hydrocarbons | -Alcohol | -Hydroelectricity<br>-Geothermic energy | -Non-conventional energy sources<br>-Pipeline development |
| 6. Housing & Construction Materials | -Low-cost housing | -Squatter settlement housing<br>-Water & sewage system | -Rural housing<br>-Construction materials | -Middle income housing |
| 7. Transport & Telecommunications | -Highways (road development) | -Community or village roads | -Urban transport<br>-Ports<br>-Railroad electrification | -Development of fishing ports<br>-Airports<br>-Expansion railroad network |

TABLE 12 (Continuation)

| Research Areas: | Main Sectorial Programs and Priority Levels: | | | |
|---|---|---|---|---|
| | Priority 1 | Priority 2 | Priority 3 | Priority 4 |
| 8. Health | -Communicable diseases<br>-Extension of medical coverage<br>-Nutrition<br>-Mother/child care<br>-Environmental sanitation | | -Mental health<br>-Occupational health | -Dental health<br>-Chronic diseases |
| 9. Social Development | -Employment<br>-Training of human resources | -Cooperatives & rural development<br>-Urban development and housing policy<br>-Improvement social services for low-income groups | -Design & management of transport system<br>-Training of skilled workers | |

Not all development problems related to each sector lead to a researchable topic and therefore to a research priority. This is something that has to be decided in each separate case. It should also be quite evident that the priority levels that appear in Table 12 are defined across the board, and not at the level of each research area. This is the reason for empty categories, such as the second level of priority for health.

A second important aspect that can be derived from the National Development Plan is the research priorities that are defined in the science and technology chapter of that plan. Eight major research areas are identified in the latter:

1) Agricultural research, with a special emphasis on basic grains, soil management, irrigation and water management, seed production and genetic improvement of main crops.

2) Industrial technological development, specially in the metalworking industry and in the construction industry.

3) Development of agroindustrial products.

4) Fisheries and use of marine resources.

5) Natural resources, specially hydrological resources, forestry and control of erosion.

6) Housing and construction materials.

7) Energy, specially technical and economic feasibility analysis of alternative sources of energy.

8) Health, with a special emphasis on the previously mentioned health aspects.

Nevertheless the science and technology chapter of the Development Plan does not present operational research programs in these eight areas. It only makes reference to some general research topics that should receive attention within each area. In order to formulate operational and feasible research programs in these eight areas, the analysis on present research activities that is presented in section 4 of this report could be taken as a starting point.

# ANNEX I

## List of Institutions Included in Survey and of Research Units within them

| Institution: | Research Unit: |
|---|---|
| 1. Universidad de Costa Rica | - Instituto de Investigaciones Jurídicas<br>- Instituto de Investigaciones Sociales<br>- Instituto de Investigaciones en Ciencias Económicas<br>- Instituto de Investigaciones Psicológicas<br>- Instituto de Investigaciones en Salud<br>- Instituto Clodomiro Picado<br>- Centro de Investigación en Tecnología de Alimentos<br>- Centro de Investigación en Biología Celular y Molecular<br>- Centro de Investigación en Ciencias del Mar y Limnología<br>- Centro de Investigaciones en Parasitología<br>- Centro de Investigación en Electroquímica y Energía Química<br>- Centro de Investigación en Hemoglobinas Anormales y Transtornos Afines<br>- Centro de Investigaciones en Productos Naturales<br>- Centro de Investigaciones Históricas<br>- Instituto de Investigación para el Mejoramiento de la Educación Costarricense<br>- Instituto de Investigaciones en Ingeniería<br>- Facultad de Bellas Artes<br>- Facultad de Letras<br>- Escuela de Estudios Generales<br>- Facultad de Ciencias<br>- Facultad de Ciencias Económicas<br>- Facultad de Ciencias Sociales<br>- Facultad de Agronomía<br>- Escuela de Arquitectura<br>- Facultad de Ingeniería<br>- Facultad de Farmacia<br>- Facultad de Medicina<br>- Facultad de Microbiología<br>- Centros Regionales<br>- Estaciones Experimentales<br>- Laboratorio de Productos Forestales |
| 2. Universidad Nacional | - Centro de Estudios Generales<br>- Facultad de Filosofía y Letras<br>- Facultad de Ciencias Sociales<br>- Facultad de Ciencias de la Tierra y el Mar<br>- Facultad de Ciencias Exactas y Naturales<br>- Facultad de Ciencias de la Salud |

ANNEX I (Continuation)

| Institution: | Research Unit: |
|---|---|
| 3. Instituto Tecnológico de Costa Rica | - Centro de Investigación en Energía<br>- Centro de Investigación en Ingeniería de Maderas<br>- Centro de Investigación y Experimentación en Construcción<br>- Centro de Investigación en Metalmecánica<br>- Centro de Investigación Forestal<br>- Centro de Investigación Agrícola<br>- Centro Químico de Investigación y Asistencia Técnica |
| 4. Ministerio de Agricultura | - Departamento de Agronomía<br>- Departamento de Café<br>- Departamento de Fitopatología<br>- Departamento de Entomología<br>- Departamento de Investigación en Zootecnia<br>- Departamento de Investigación Forestal |
| 5. Instituto Costarricense de Investigación y Enseñanza en Nutrición y Salud | - Unidad de Nutrición Aplicada y Bromatología<br>- Unidad de Sociobiología<br>- Unidad de Ecología Médica<br>- Unidad de Bioquímica y Genética Humana |
| 6. Junta del Tabaco | - Departamento de Investigaciones |
| 7. Ministerio de Salud | - Departamento de Salud Mental |
| 8. Consejo Nacional de Ciencia y Tecnología | - Unidad de Política Científica y Tecnológica |
| 9. Tabacalera Costarricense | - Sección de Investigación |
| 10. Asociación Bananera Nacional | - Departamento de Diversificación Agrícola<br>- Departamento de Investigaciones |
| 11. Asociación Demográfica Costarricense | - Departamento de Investigaciones Sociodemográficas |
| 12. Consejeros Económicos y Financieros, S.A. | - (No internal division; single cell organization) |
| 13. Academia de Centroamérica | - (No internal division; single cell organization) |

# ANNEX II

## STATISTICAL TABLES

TABLE II-1

Distribution of Research Effort by Research Area and Research Topics in Costa Rica

(In thousands of Colones and US$)

| Research Areas and Research Topics | No. Research Projects | Financial Resources | | | No. of Researchers |
|---|---|---|---|---|---|
| | | Colones | US$ | % | |
| 1. Natural resources & environment | | | | | |
| 1.1 Environmental pollution | 11 | 971.0 | 64.1 | 1.24 | 5.1 |
| 1.2 Knowledge of natural resources | 2 | 255.6 | 16.9 | 0.33 | 1.5 |
| 1.3 Flora and fauna | 25 | 1.826.8 | 120.6 | 2.33 | 11.8 |
| 1.4 Hydrological resources | 3 | 221.9 | 14.6 | 0.29 | 2.2 |
| 1.5 Knowledge on soils | 15 | 1.738.7 | 114.7 | 2.21 | 12.4 |
| Sub-Total | 56 | 5.014.0 | 330.9 | 6.40 | 33.0 |
| 2. Agriculture, forestry & fisheries | | | | | |
| 2.1 Agricultural production | 263 | 21.644.9 | 1.428.4 | 27.54 | 88.0 |
| 2.2 Forestry | 14 | 4.984.3 | 328.9 | 6.34 | 19.0 |
| 2.3 Animal production | 33 | 3.499.7 | 231.0 | 4.45 | 19.0 |
| 2.4 Post-production systems | 7 | 648.1 | 42.8 | 0.82 | 4.0 |
| 2.5 Fisheries and biological water resources | 18 | 2.349.1 | 155.0 | 2.98 | 14.0 |
| 2.6 Soil management | 19 | 871.1 | 57.5 | 1.10 | 4.0 |
| 2.7 Multiple cropping systems | 11 | 825.4 | 54.5 | 1.05 | 5.0 |
| 2.8 Others | - | 1.117.4 | 73.7 | 1.42 | - |
| Sub-Total | 365 | 35.940.0 | 2.371.8 | 45.70 | 153.0 |
| 3. Mining | | | | | |
| 3.1 Coal | 2 | 258.2 | 17.0 | 0.34 | 1.4 |
| 3.2 Uranium | 1 | 73.3 | 4.8 | 0.10 | 0.4 |
| 3.3 Bismuth | 1 | 37.5 | 2.5 | 0.06 | 0.4 |
| 3.4 Manganese | 1 | 22.6 | 1.5 | 0.04 | 0.4 |
| 3.5 Bauxite | 1 | 35.6 | 2.4 | 0.06 | 0.4 |
| Sub-Total | 6 | 427.2 | 28.2 | 0.60 | 3.0 |
| 4. Industrial Technology | | | | | |
| 4.1 Alcohol production | 1 | 159.2 | 10.5 | 0.21 | 1.5 |
| 4.2 Beverage & liquor industry | 1 | 88.5 | 5.8 | 0.12 | 1.0 |
| 4.3 Machinery construction | 3 | 301.3 | 19.9 | 0.39 | 1.6 |
| 4.4 Leather industry | 2 | 151.2 | 10.0 | 0.20 | 1.3 |
| 4.5 Wood industry | 1 | 247.8 | 16.4 | 0.32 | 1.0 |
| 4.6 Metal-mechanical industry | 1 | 261.2 | 17.2 | 0.34 | 1.0 |
| 4.7 Pharmaceutical industry | 1 | 133.6 | 8.8 | 0.17 | 0.8 |
| 4.8 Food industry | 2 | 123.4 | 8.2 | 0.16 | 0.6 |
| 4.9 Detergent industry | 1 | 30.7 | 2.0 | 0.04 | 0.2 |
| 4.10 Others | 1 | 111.9 | 7.4 | 0.15 | 1.0 |
| Sub-Total | 14 | 1.608.8 | 106.2 | 2.10 | 10.0 |

TABLE II-1 (Continuation)

| Research Areas and Research Topics | No. Research Projts. | Financial Resources | | | No. of Researchers |
|---|---|---|---|---|---|
| | | Colones | US$ | % | |
| 5. Energy resources | | | | | |
| 5.1 Solar energy | 5 | 375.6 | 24.8 | 0.48 | 3.3 |
| 5.2 Alcohol | 3 | 534.7 | 35.3 | 0.68 | 3.0 |
| 5.3 Biomass - biogas | 4 | 2.880.9 | 190.1 | 3.67 | 1.6 |
| 5.4 Aeolic energy | 1 | 146.6 | 9.7 | 0.19 | 1.0 |
| 5.5 Hydroelectricity | 2 | 144.9 | 9.5 | 0.19 | 0.7 |
| 5.6 Coal | 1 | 17.9 | 1.2 | 0.03 | 0.1 |
| 5.7 Combustibles | 1 | 48.6 | 3.2 | 0.06 | 0.3 |
| Sub-Total | 17 | 4.149.2 | 273.8 | 5.30 | 10.0 |
| 6. Housing and development of construction technologies and materials | | | | | |
| Sub-Total | 10 | 1.048.6 | 69.2 | 1.30 | 7.0 |
| 7. Transportation and telecommunication | | | | | |
| Sub-Total | 1 | 159.2 | 10.5 | 0.20 | 1.0 |
| 8. Health | | | | | |
| 8.1 Rural health | 2 | 198.9 | 13.1 | 0.25 | 1.0 |
| 8.2 Water supply & sanitation | 1 | 42.4 | 2.8 | 0.05 | 0.3 |
| 8.3 Bacteriology- microbiology & parasitology | 9 | 691.6 | 45.6 | 0.88 | 5.0 |
| 8.4 Nutrition & dietetics | 16 | 2.956.8 | 195.1 | 3.76 | 12.7 |
| 8.5 Biochemestry & human genetics | 9 | 993.7 | 65.6 | 1.26 | 5.0 |
| 8.6 Traditional medicine | 3 | 185.5 | 12.2 | 0.23 | 1.1 |
| 8.7 Family planning | 1 | 82.3 | 5.4 | 0.10 | 0.4 |
| 8.8 Hematology | 3 | 274.4 | 18.1 | 0.35 | 1.5 |
| 8.9 Immunology | 2 | 136.8 | 9.0 | 0.17 | 0.6 |
| 8.10 Pharmacology & therapeutics | 5 | 195.6 | 12.9 | 0.25 | 1.3 |
| 8.11 Epidemiology | 10 | 3.173.8 | 209.5 | 4.03 | 16.4 |
| 8.12 Cancerology | 3 | 206.9 | 13.7 | 0.27 | 1.2 |
| 8.13 Pathology & cytopathology | 4 | 416.5 | 27.5 | 0.53 | 2.0 |
| 8.14 Physiology & physiopathology | 2 | 115.1 | 7.6 | 0.15 | 0.5 |
| 8.15 Toxicology | 6 | 828.9 | 54.7 | 1.06 | 7.7 |
| 8.16 Social medicine | 4 | 697.3 | 46.1 | 0.88 | 5.7 |
| 8.17 Mental health | 9 | 699.7 | 46.2 | 0.88 | 10.6 |
| Sub-Total | 89 | 11,896.2 | 785.1 | 15.10 | 73.0 |

TABLE II-1 (Continuation)

| Research Areas and Research Topics | No. Research Projects | Financial Resources | | | No. of Researchers |
|---|---|---|---|---|---|
| | | Colones | US$ | % | |
| 9. Social science | | | | | |
| 9.1 Population | 17 | 2.551.5 | 157.6 | 3.04 | 12.6 |
| 9.2 Rural development & agricultural economics | 15 | 3.285.9 | 142.0 | 2.74 | 11.0 |
| 9.3 Societal organization: macro-economic & macro-sociological processes | 28 | 4,679.8 | 213.0 | 4.11 | 23.5 |
| 9.4 Production & distribution | 2 | 549.6 | 36.3 | 0.70 | 1.2 |
| 9.5 Organization & administration of the State | 17 | 1,492.9 | 98.5 | 1.90 | 8.8 |
| 9.6 Urban development | 3 | 538.7 | 35.6 | 0.69 | 4.6 |
| 9.7 Education | 30 | 2,281.0 | 150.5 | 2.90 | 20.8 |
| 9.8 Communication & information | 4 | 824.9 | 54.4 | 1.05 | 7.0 |
| 9.9 Science & technology | 3 | 607.1 | 40.1 | 0.77 | 3.2 |
| 9.10 Anthropology & culture | 14 | 1,030.5 | 68.0 | 1.30 | 7.3 |
| Sub-Total | 133 | 17,841.9 | 996.0 | 19.20 | 100.0 |
| 10. Basic knowledge | | | | | |
| Sub-Total | 46 | 3,247.9 | 214.3 | 4.10 | 21.0 |
| TOTAL | 737 | 81,333.0 | 5,186.0 | 100.00 | 411.0 |

TABLE II-2

Main Research Topics in Forestry (ongoing projects)

(In thousands of Colones and US$)

| Research Topics in Forestry | No. Research Projects | Financial Resource | | | No. of Researchers |
|---|---|---|---|---|---|
| | | Colones | US$ | % | |
| 1. Reforestation | 1 | 4.6 | 0.3 | 0.1 | 0.2 |
| 2. Utilization | 6 | 1.753.3 | 115.7 | 35.2 | 7.4 |
| 3. Agro-silviculture | 3 | 1.544.5 | 101.9 | 31.0 | 5.2 |
| 4. Forestry improvement | 4 | 1.681.9 | 111.0 | 33.7 | 6.2 |
| TOTAL | 14 | 4.984.3 | 328.9 | 100.0 | 19.0 |

TABLE II-3

Main Research Topics in Animal Production (ongoing projects)

(In thousands of Colones and US$)

| Research Topics in Animal Production | No. Research Projects | Financial Resources | | | No. of Researchers |
|---|---|---|---|---|---|
| | | Colones | US$ | % | |
| 1. Livestock products | 11 | 1.289.4 | 85.1 | 36.8 | 7.0 |
| 2. Pastures and forages | 12 | 1.392.9 | 91.9 | 39.8 | 7.0 |
| 3. Animal nutrition | 4 | 349.6 | 23.1 | 10.0 | 1.8 |
| 4. Animal health | 2 | 158.0 | 10.4 | 4.5 | 1.0 |
| 5. Minor species | 4 | 309.8 | 20.5 | 8.9 | 2.2 |
| TOTAL | 33 | 3.499.7 | 231.0 | 100.0 | 19.0 |

TABLE II-4

Main Research Topics in Post-Production (ongoing projects)

(In thousands of Colones and US$)

| Research Topics in Post Production | No. Research Projects | Financial Resources | | | No. of Researchers |
|---|---|---|---|---|---|
| | | Colones | US$ | % | |
| 1. Drying of agricultural products | 1 | 203.0 | 13.4 | 31.3 | 1.0 |
| 2. Cassava storage and preservation | 1 | 55.8 | 3.7 | 8.7 | 0.3 |
| 3. Extraction of walnut oil and protein evaluation | 1 | 48.3 | 3.2 | 7.5 | 0.2 |
| 4. Utilization of banana fiber | 1 | 85.1 | 5.6 | 13.1 | 0.4 |
| 5. Onion storage | 1 | 19.4 | 1.3 | 3.0 | 0.1 |
| 6. Fish processing | 1 | 123.5 | 8.1 | 18.9 | 1.0 |
| 7. Extracting of coloring substance from annato seeds | 1 | 113.0 | 7.5 | 17.5 | 1.0 |
| TOTAL | 7 | 648.1 | 42.8 | 100.0 | 4.0 |